

Frequency vs. Period

Video Notes

Waves are repeated and periodic disturbances in a medium that cause particles to vibrate about a fixed position. Frequency and period are two quantities that describe the particles' motion.



Frequency

- refers to **how often** the particles complete a back-and-forth vibrational cycle.
- the number of vibrations or cycles per time
- calculated by dividing the number of cycles by the time
- units = cycles/second or Hertz (Hz)
- should not be confused with speed (speed refers to **how fast** a crest travels along a medium; it is a distance/time ratio)

$$\text{Frequency} = \frac{\text{\# of cycles}}{\text{time}}$$

Period

- refers to **how much time** it takes a particle to complete one full vibrational cycle.
- the time per cycle
- calculated by dividing the time by the number of cycles
- units = time units (seconds, minutes, hours, etc.)

$$\text{Period} = \frac{\text{time}}{\text{\# of cycles}}$$

Frequency vs. Period

An inspection of the equations for frequency and period demonstrate that ...

$$\text{Frequency} = \frac{\text{\# of cycles}}{\text{time}}$$

$$\text{Period} = \frac{\text{time}}{\text{\# of cycles}}$$

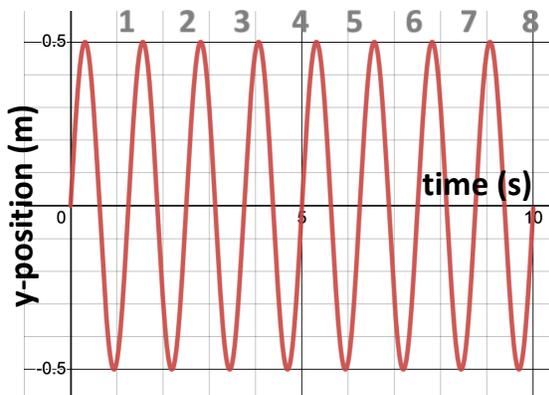
... frequency and period are reciprocals of one another.

- So if you know the frequency, you can calculate the period. And vice versa.
- And as the frequency increases, the period decreases. And vice versa.

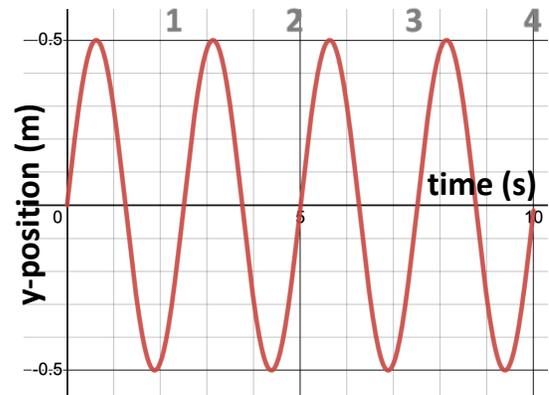
$$f = \frac{1}{T} \quad T = \frac{1}{f}$$

Graphical Representation

These two graphs portray the position of a vibrating particle as a function of time. The graph on the left shows a greater number of cycles during the same amount of time. It has the greater frequency and the smaller period.



More cycles per time
Greater frequency
Smaller period



Less cycles per time
Smaller frequency
Greater period

Doing the Math

- To calculate frequency and period, look for information about the **number of cycles** of vibration and the corresponding amount of **time**.
- Take the numbers for these quantities and put them in the right place in the equations.
- Use your calculator to determine the answers.
- Include the appropriate unit on your answers.

Example:

As a student shakes a rope, the rope makes 56 complete vibrations in 14 seconds. Determine the frequency and the period.

of cycles

time

$$\text{Frequency} = \frac{\text{\# of cycles}}{\text{time}} = \frac{56 \text{ cycles}}{14 \text{ s}} = 4.0 \text{ Hz}$$

$$\text{Period} = \frac{\text{time}}{\text{\# of cycles}} = \frac{14 \text{ s}}{56 \text{ cycles}} = 0.25 \text{ s}$$